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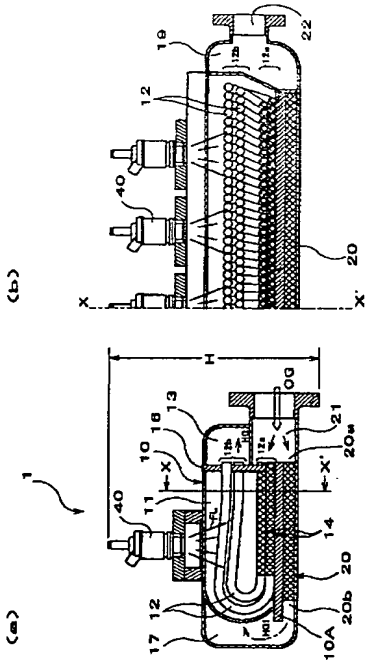
(54)【発明の名称】　燃料蒸発器

(57)【要約】
【課題】　燃料蒸発器の高さを低くすることができ、かつ、触媒燃焼して発生した高温熱媒体の配管から系外への熱損失を少なくすることができる燃料蒸発器を提供することを目的とする。
【解決手段】　液体原燃料を蒸発させることが可能な高温熱媒体を通す熱媒チューブを備え、前記熱媒チューブから得られる熱により前記液体原燃料を蒸発させる蒸発室を有する燃料蒸発器において、前記熱媒チューブ１２の中には、被燃焼体を燃焼させる触媒燃焼部１４を備えることを特徴とする燃料蒸発器を解決手段とする。



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【特許請求の範囲】

【請求項１】　液体原燃料を蒸発させることが可能な高温熱媒体を通す熱媒チューブを備え、前記熱媒チューブから得られる熱により前記液体原燃料を蒸発させる蒸発室を有する燃料蒸発器において、前記熱媒チューブの中には、被燃焼体を燃焼させる触媒燃焼部を備えることを特徴とする燃料蒸発器。

【請求項２】　前記蒸発室に隣接する触媒燃焼器と、前記蒸発室が隣接した以外の部位に、前記液体原燃料を蒸発させた後の前記高温熱媒体が通流する高温熱媒体通路とを備えたことを特徴とする請求項１に記載の燃料蒸発器。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、燃料電池システムにおける液体原燃料の燃料蒸発器に関し、さらに詳しくは、蒸発室内の熱媒チューブの内側に被燃焼体を燃焼させる触媒燃焼部を備えた燃料蒸発器に関する。

【０００２】

【従来の技術】燃料電池システムは、水素を燃料ガスとして燃料電池の水素極（陰極）に供給するとともに、酸素を含有する酸化ガスを燃料電池の酸素極（陽極）に供給して発電を行う燃料電池を中核とした発電システムである。この燃料電池システムは、化学エネルギーを直接電気エネルギーに変換するものであり、高い発電効率を有することや有害物質の排出量が極めて少ないこと等から最近注目されている。

【０００３】従来の燃料電池システムで使用される燃料蒸発器は、例えば特願平１１－１２５３６６号に記載されている。この燃料蒸発器１００は、図６に示すように、触媒燃焼器の中で、被燃焼体を触媒反応で燃焼させることにより発生させた高温熱媒体である燃焼ガスＨＧを、蒸発器本体１１０に導入するための入口部１１４と、前記燃焼ガスＨＧをＵ字形の熱媒チューブ１１２の入口部１１２ａから出口部１１２ｂまでの内側に通流して、原燃料噴射装置１４０から前記熱媒チューブ１１２の外表面に噴射される液体原燃料ＦＬを前記燃焼ガスＨＧから得られる熱により蒸発させる蒸発室１１１と、液体原燃料ＦＬの蒸発を行った後の前記燃焼ガスＨＧが通流する蒸発室１１１の下面１１０Ａに設けられる燃焼ガス通路１１３と、前記蒸発室１１１で蒸発した原燃料ガスＦＧを、前記燃焼ガス通路１１３を経由した燃焼ガスＨＧにより過熱するための過熱室１３２と蒸気チューブ１３１とから形成される過熱部１３０とから主要部が構成される。

【０００４】以上から構成される従来の燃料蒸発器１００の作用について述べる。図示しない触媒燃焼器で被燃焼体を燃焼させて生成した高温熱媒体である燃焼ガスＨＧは、蒸発器本体１１０の入口部１１４に導入される。入口部１１４に導入された燃焼ガスＨＧは、蒸発室１１

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１内のＵ字形をした熱媒チューブ１１２内の入口部１１２ａから出口部１１２ｂまでを上から下に通過し、蒸発室１１１内で前記熱媒チューブ１１２の外表面に原燃料噴射装置１４０により噴射される液体原燃料ＦＬを蒸発させる。次に、前記液体原燃料ＦＬを蒸発させた後の燃焼ガスＨＧは、燃焼ガス通路１１３を経由して過熱部１３０の過熱室１３２へと導かれ、蒸発室１１１内で蒸発した原燃料ガスＦＧを蒸気チューブ１３１の外側からさらに過熱する。過熱された原燃料ガスＦＧは図示しない改質器へと導入され、原燃料ガスＦＧを過熱した後の燃焼ガスＨＧは排ガスとして系外に排出される。

【０００５】しかしながら、従来の燃料蒸発器１００は、図６に示すような、蒸発器本体１１０の蒸発室１１１の下面１１０Ａに燃焼ガス通路１１３を設けたり、図示しない触媒燃焼器を蒸発室１１１の下面１１０Ａに隣接して設けるため、燃料蒸発器１００の全体の高さＨ１が高くなり、燃料電池システムを車両に搭載したときに、車高が高くなってしまうという問題があった。また、触媒燃焼器を蒸発室１１１の下面１１０Ａに隣接して設ける場合に、触媒燃焼器の出口から蒸発室１１１内の熱媒チューブ１１２までの配管のところで系外への熱損失があり（温度降下ΔＴ＝２０～３０℃）、せっかく触媒燃焼器で発生した高温の燃焼ガスＨＧの保有熱量が無駄になってしまうという問題があった。

【０００６】

【発明が解決しようとする課題】本発明は、前記課題を解決するためになされたものであって、燃料蒸発器の高さを低くすることができ、かつ、触媒燃焼して発生した高温熱媒体の配管から系外への熱損失を少なくすることができる燃料蒸発器を提供することを目的とする。

【０００７】

【課題を解決するための手段】前記課題を解決するための請求項１に記載された発明の要旨とするところは、液体原燃料を蒸発させることが可能な高温熱媒体を通す熱媒チューブを備え、前記熱媒チューブから得られる熱により前記液体原燃料を蒸発させる蒸発室を有する燃料蒸発器において、前記熱媒チューブの中には、被燃焼体を燃焼させる触媒燃焼部を備えることを特徴とするものである。

【０００８】蒸発室内の熱媒チューブの内側に、触媒燃焼反応により被燃焼体を燃焼させる触媒燃焼部を設けて、触媒燃焼器と燃料蒸発器を一体化した構成とすることにより、従来、燃料蒸発器の前段に設けられていた触媒燃焼器の設置スペースを不要とし、燃料蒸発器全体の高さＨを小さくできる。その結果、車両に燃料電池システムを搭載したときの車高を小さくすることができる。また、一体化した構成とすることにより触媒燃焼器から燃料蒸発器の熱媒チューブまでの配管から系外への熱損失がなくなる。

【０００９】前記課題を解決するための請求項２に記載

された発明の要旨とするところは、前記蒸発室に隣接する触媒燃焼器と、前記蒸発室が隣接した以外の部位に、前記液体原燃料を蒸発させた後の前記高温熱媒体が通流する高温熱媒体通路とを備えたことを特徴とする請求項１に記載の燃料蒸発器である。

【００１０】蒸発室の下面に隣接するように触媒燃焼器を設けて、蒸発室の加熱・保温用の高温熱媒体を発生させるだけでなく、蒸発室内の熱媒チューブ内の触媒燃焼部で発生した高温熱媒体を蒸発室の周囲に設けた高温熱媒体通路に通流させて、さらに蒸発室を加熱・保温することにより、速やかに蒸発が行われる。従って、触媒燃焼記および高温熱媒体通路を設けない場合と比較して、オフガスを触媒燃焼する量を少なくできるので、触媒装填量を減らすことができる。その結果、触媒燃焼器の高さを低くでき、全体として燃料蒸発器をコンパクト化することができる。

【００１１】

【発明の実施の形態】本発明に係る燃料蒸発器の実施の形態について図面を参照して説明する。図１は、本発明に係る燃料電池システムの全体系統図、図２（ａ）は、本発明に係る燃料蒸発器の側断面図、図２（ｂ）は、図２（ａ）のＸ－Ｘ′断面図（左半分省略）、図３（ａ）は、本発明に係る触媒燃焼部の第一実施形態を示す横断面の斜視図、図３（ｂ）は、本発明に係る触媒燃焼部の第二実施形態を示す横断面の斜視図、図４（ａ）は、本発明に係る触媒燃焼器の第一実施形態を示す横断面の斜視図．図４（ｂ）は、本発明に係る触媒燃焼器の第二実施形態を示す横断面の斜視図、図４（ｃ）は、本発明に係る触媒燃焼器の第三実施形態を示す横断面の斜視図、図５は、本発明に係る燃料蒸発器の燃焼ガス通路を示す斜視図である。

【００１２】最初に、図１および図２を参照して本発明に係る燃料電池システムＦＣＳ全体について説明する。車両に搭載される燃料電池システムＦＣＳは、蒸発器本体１０の蒸発室１１内に、その内側に燃料電池５のオフガスＯＧを触媒燃焼して発生した高温熱媒体である燃焼ガスＨＧを通流して外表面で接触する前記液体原燃料ＦＬを蒸発させるＵ字形の熱媒チューブ１２と前記熱媒チューブ１２の内側に触媒燃焼部１４とを備えた燃料蒸発器１と、前記燃料蒸発器１で前記液体原燃料ＦＬを蒸発させて生成した原燃料ガスＦＧを、固体触媒上で反応させて燃料ガスにする改質器２と、前記改質器２で生成される前記燃料ガス中の一酸化炭素を除去するＣＯ除去器３と、前記ＣＯ除去器３から供給される燃料ガス中の水素と酸化剤供給手段である空気圧縮機４により圧縮された空気中の酸素とを反応させて発電を行う燃料電池５と、燃料電池５の水素極のオフガスＯＧから水分を分離・除去する気液分離装置６と、気液分離装置６から供給されるオフガスＯＧや補助燃料を燃焼して起動時等で燃料蒸発器１の加熱源となる高温熱媒体である燃焼ガスＨＧを発生する補助燃料（例えばメタノール）の供給ラインを有する燃焼バーナ７とを含んで構成される。

【００１３】前記のように構成される燃料電池システムＦＣＳの作用について述べる。液体原燃料ＦＬ（例えばメタノールと水の混合燃料）が、ポンプにより、液体原燃料貯蔵タンクＴから燃料蒸発器１に所定量供給される。燃料蒸発器１の蒸発器本体１０に供給された液体原燃料ＦＬは、原燃料噴射装置４０により蒸発器本体１０の蒸発室１１内に設けられたＵ字形の熱媒チューブ１２の外表面に噴射される。前記蒸発室１１内の前記熱媒チューブ１２には、熱媒チューブ１２の内側に設けられた触媒燃焼部１４で、燃料電池５の水素極のオフガスＯＧを燃焼して発生した高温熱媒体である燃焼ガスＨＧが流れており、前記液体原燃料ＦＬは、熱媒チューブ１２を介して前記燃焼ガスＨＧから得られる熱により蒸発室１１内で原燃料ガスＦＧとして蒸発される。蒸発器本体１０の加熱源としては、運転時は、熱媒チューブ１２内の触媒燃焼部１４で燃料電池５の水素極のオフガスＯＧや補助燃料を燃焼して触媒燃焼することで発生する燃焼ガスＨＧを使用するが、起動時等で加熱源がない場合は、燃焼バーナ７で補助燃料（例えばメタノール）を燃焼して必要熱量を確保できるようになっている。

【００１４】前記蒸発器本体１０で発生した原燃料ガスＦＧは、過熱部３０で凝縮しない温度まで過熱されて改質器２に導入され、改質器２に導入された原燃料ガスＦＧは、固体触媒（例えばＣｕ－Ｚｎ系の触媒）上で反応させられて水素リッチな燃料ガスを製造する。さらに、改質器２で生成された水素リッチな燃料ガスは、ガス中の一酸化炭素をＣＯ除去器３で除去された後、前記ＣＯ除去器３から供給される燃料ガス中の水素と酸化剤供給手段である空気圧縮機４により圧縮された空気中の酸素とを反応させて発電を行う燃料電池５に導入される。燃料電池５で反応した後の水素極のオフガスＯＧは、気液分離装置６で水分を分離・除去された後、再び触媒燃焼部１４で燃焼されて蒸発器本体１０の加熱源となる。なお、蒸発器本体１０で発生した原燃料ガスＦＧが充分に凝縮しない熱量を有していれば過熱器３０を通さずに直接改質器２に導入しても良い。

【００１５】以下、図２乃至図５を参照して本発明に係る燃料蒸発器１の実施形態について詳細に説明する。本発明に係る燃料蒸発器１は、被燃焼体である燃料電池５の水素極のオフガスＯＧを導入する燃料蒸発器１の入口部２１と、前記入口部２１に連設し、その内側に、前記オフガスＯＧの大部分を通して触媒燃焼させる触媒燃焼部１４を有し、前記触媒燃焼部１４から発生する高温熱媒体である燃焼ガスＨＧにより、外表面で接触する液体原燃料ＦＬを蒸発させるＵ字形をした熱媒チューブ１２と、前記熱媒チューブ１２を保持するチューブ保持部１６と、前記熱媒チューブ１２および前記チューブ保持部１６を囲んだ部屋である蒸発室１１と、前記蒸発室１１

の上部に設けられ、液体原燃料ＦＬを前記蒸発室１１内に噴射する原燃料噴射装置４０とから構成される蒸発器本体１０と、前記蒸発室１１内で液体原燃料ＦＬを蒸発させた後の燃焼ガスＨＧが、蒸発室１１の側部を保温するように蒸発室１１の周囲に設けられた高温熱媒体通路である燃焼ガス通路１３，１７，１８，１９と、前記蒸発室１１の下面１０Ａに隣接して設けられ、前記オフガスＯＧの残分を触媒燃焼させた高温熱媒体である燃焼ガスＨＧ１により蒸発室１１底部の液体原燃料ＦＬを蒸発させる触媒燃焼器２０と、前記燃焼ガスＨＧ１と前記燃焼ガス通路１３，１８を通った燃焼ガスＨＧとが合流した高温熱媒体である燃焼ガスＨＧ２により原燃料ガスＦＧを過熱する図示しない過熱部３０と、から主要部が構成される。

【００１６】次に、本発明に係る燃料蒸発器１の作用について図２を参照して説明する。被燃焼体である燃料電池５の水素極のオフガスＯＧは、燃料蒸発器１の入口部２１を通って、チューブ保持部１６に保持されたＵ字形の熱媒チューブ１２の入口部１２ａで２つの流れに分岐する。

【００１７】分岐したうちの１つの流れは、図２に示すように、そのまま熱媒チューブ１２の入口部１２ａに設けられた触媒燃焼部１４へと流れ、オフガスＯＧを燃焼して高温熱媒体である燃焼ガスＨＧを生成し、生成した高温の燃焼ガスＨＧは、蒸発室１１内に設けられたＵ字形の熱媒チューブ１２内を下から上へと流れる。前記燃焼ガスＨＧは、蒸発室１１内のＵ字形をした熱媒チューブ１２内を通るときに、前記熱媒チューブ１２の外表面へ原燃料噴射装置４０により噴射される液体原燃料ＦＬを燃焼ガスＨＧの保有熱で蒸発させ、原燃料ガスＦＧを生成する。次に、液体原燃料ＦＬを蒸発した後の燃焼ガスＨＧは、熱媒チューブ１２の出口１２ｂから燃焼ガス通路１３に排出され、図５に示すように、蒸発室１１の周りを囲むようにして設けられた燃焼ガス通路１３，１８を経由して、燃焼ガス通路１７において触媒燃焼器２０で発生した高温熱媒体である燃焼ガスＨＧ１と合流する。さらに合流した高温熱媒体である燃焼ガスＨＧ２は、燃焼ガス通路１９および出口部２２を通って過熱部３０（図1参照）へと導かれ、蒸発室１１内で蒸発した原燃料ガスＦＧを凝縮しない温度まで過熱する。

【００１８】一方、分岐したうちのもう１つの流れは、図２に示すように、蒸発室１１の下面１０Ａに隣接して設けられ、長方形の断面形状をした触媒燃焼器２０の入口部２０ａへと流れ、装填された触媒でオフガスＯＧを燃焼することにより触媒燃焼器の出口２０ｂから高温熱媒体である燃焼ガスＨＧ１を発生する。触媒燃焼器２０で発生した燃焼ガスＨＧ１は、蒸発室１１底部の液体原燃料ＦＬを蒸発した後、図５に示すように、蒸発室１１から排出された燃焼ガスＨＧと燃焼ガス通路１７で合流し、合流した燃焼ガスＨＧ２は、燃焼ガス通路１９，２２を通って蒸発室１１の後段に設けられる図示しない過熱部３０へと導かれる。過熱部３０を出た燃焼ガスＨＧ２は、排ガスとして系外に排出され、過熱された原燃料ガスＦＧは改質器２へと導入される。

【００１９】次に、本発明に係る燃料蒸発器１の熱媒チューブ１２に設けられる触媒燃焼部１４について図３を参照して詳細に説明する。触媒燃焼部１４は、燃料蒸発器１の蒸発室１１内の熱媒チューブ１２の内側に従来の触媒燃焼器の触媒と同じ触媒をを装填して触媒燃焼器と燃料蒸発器を一体化したものである。第一実施形態の触媒燃焼部１４の構造は、図３（ａ）に示すように、格子状のハニカム触媒１４ａを熱媒チューブ１２内に装填したものである。図３（ａ）では触媒セルの形状が４角形を示しているが６角形のものでも良い。ハニカム触媒１４ａの製法としては、通常、セラミックス担体表面にγ-アルミナや酸化ジルコニウムなど比表面積の大きな担体を被覆し、その上に白金その他の活性成分を含浸する方法で触媒が調製される。ハニカム触媒１４ａは、担体に触媒活性成分を担持したものを熱媒チューブ１２に装填してもよいし、最初にハニカム担体のみを装填し、熱媒チューブ１２の内面およびハニカム担体に後から触媒活性成分を担持させるように調製しても良い。ハニカム触媒１４ａは、オフガスＯＧと触媒活性成分との接触面積および触媒内のガスの線速度を大きくとれるので、ダスト等の固形分粒子を多く含んだガスを流したときの詰まりに対しては、固定床用の粒状触媒を装填したときよりも寿命が長い。ハニカム触媒１４ａの担体の材質は、セラミックスとしてはコーディエライト（$2MgO-2Al_2O_3-5SiO$）、ムライト（$3Al_2O3-2SiO_2$）等が良く使用されているが、金属も担体として使用できる。前記ハニカム担体は、主として高流速条件下での圧力損失、および熱履歴による触媒の粉化を防ぐ目的で使用される蜂の巣状に押し出し成型された担体である。ハニカム担体は、比活性の高い貴金属触媒（例えば白金）を少量（ハニカム担体の重量をも含めた全触媒量に対して１%以下）担持するのに適している。

【００２０】第二実施形態の触媒燃焼部１４の構造は、図３（ｂ）に示すように、平板状フェライト系ステンレスＰＬと同じ素材の波板ＷＰとをろう付け加工した触媒セルを交互に渦巻き状に巻き回したハニカム体からなり、それをステンレス製（例えばＳＵＳ３１６Ｌ）の熱媒チューブ１２内に装填したものである。平板状フェライト系ステンレスＰＬと波板ＷＰの間および前記ハニカム体と熱媒チューブ１２の間は、耐熱性の高いＮｉろう材により接合される。波板ＷＰを設けたハニカム体とすることで燃料電池５のオフガスＯＧと触媒活性成分との接触面積を大きくすることができ、平板ＰＬで波板ＷＰの上下を挟むように巻き回したことで、熱媒チューブ１２内に装填するときに、波板ＷＰにかかる偏荷重による変形を防止できる。触媒は、金属担体に触媒活性成分を

担持したものを熱媒チューブ１２に装填してもよいし、最初に金属担体のみを装填し、熱媒チューブ１２の内面および前記金属担体に後から触媒活性成分を担持させるように調製しても良い。

【００２１】第三実施形態の触媒燃焼部１４の構造は、図示しないが、１枚の長方形の板を捻った形状の捻れフィンの担体に金属活性成分を担持した捻れフィン触媒を、蒸発室１１内の熱媒チューブ１２内に装填したものである。このようにすることにより、捻れフィンにより熱媒チューブ１２内の触媒燃焼部１４で発生した燃焼ガスＨＧの流れを乱流化することができる。乱流化することにより、熱媒チューブ１２内の半径方向の温度分布がなくなり伝熱係数が大きくなるので、触媒燃焼部１４で発生させた燃焼ガスＨＧの保有熱量が、蒸発器本体１０の蒸発室１１内における液体原燃料ＦＬの蒸発に有効に利用できる。従って、液体原燃料ＦＬの蒸発を促進することができる。触媒は、金属担体に触媒活性成分を担持したものを熱媒チューブ１２に装填してもよいし、最初に金属担体のみを装填し、熱媒チューブ１２の内面および前記金属担体に後から触媒活性成分を担持させるように調製しても良い。

【００２２】次に、蒸発室１０の下面１０Ａに隣接して設けられる触媒燃焼器２０の構造について図４を参照して説明する。触媒燃焼器２０は、燃料電池５の水素極から排出されるオフガスＯＧを触媒燃焼して発生した燃焼ガスにより蒸発室１１の下面１０Ａから蒸発室１１を加熱・保温するための設備であり、蒸発室１１の下面１０Ａに隣接して好ましくは密着して設けられる。第一実施形態の触媒燃焼器２０の構造は、図４（ａ）に示すように、触媒セルの断面形状が、波板ＷＰ１の上下を平板ＰＬ１で挟んだ形状をしており、断面形状が長方形の配管の中に前記触媒セルを積層して装填したものである。このように、触媒燃焼器２０の断面形状を長方形とすることにより、蒸発室１０の下面１０Ａと触媒燃焼器２０との接触面積（伝熱面積）を最大限に大きくできるので、触媒燃焼器２０で発生した高温熱媒体である燃焼ガスＨＧ１の保有熱量を蒸発室１０の下面１０Ａに有効に伝えることができる。また、触媒活性の高い触媒を使用すればさらに触媒燃焼器２０の高さを小さくできる。従って、車両に燃料電池システムＦＣＳを搭載したときの車高を低くできる。

【００２３】第二実施形態の触媒燃焼器２０の構造は、図４（ｂ）に示すように、触媒セルの断面形状が、図４（ａ）と同様な波板の上下を平板で挟んだ断面形状をしており、円筒形の配管中に前記触媒セルをドーナツ状（同心円状）に積層して装填した後、上下から円筒形の配管を潰して配管の上下に平担部を形成した横長の長円形をしている。このような構造とすることにより、蒸発室１０の下面１０Ａとの接触面積（伝熱面積）を円筒形の配管に触媒を装填したときよりも大きくすることができ、触媒燃焼器２０で発生した高温熱媒体である燃焼ガスＨＧ１の保有熱量を、蒸発室１１底部の液体原燃料ＦＬの蒸発に有効に利用できる。

【００２４】第三実施形態の触媒燃焼器２０の構造は、図４（ｃ）に示すように、第二実施形態の触媒燃焼器２０の上面をカットして、上に平板を溶接付けした横長の半長円形をしている。このような構造にすれば、第二実施形態の触媒燃焼器２０よりもさらに蒸発室１１の下面１０Ａとの接触面積（伝熱面積）を大きくでき、触媒燃焼器２０で発生した燃焼ガスＨＧ１の保有熱量を蒸発室１１底部の液体原燃料ＦＬの蒸発に有効に利用できる。

【００２５】第四実施形態の触媒燃焼器２０の構造は、図示しないが、第一実施形態の触媒燃焼器（図４（ａ）参照）と同様な断面形状が長方形の中空配管の内側に、図３（ａ）の第一実施形態の触媒燃焼部または図３（ｂ）の第二実施形態の触媒燃焼部である触媒を装填した円筒形の配管を水平方向に並列配置したものである。水平方向に配置することにより、蒸発室１１の底面と触媒燃焼器との接触面積（伝熱面積）を最大限大きくでき、並列配置にすることで触媒燃焼器の高さを高くしないで処理能力をアップすることができる。その結果、触媒燃焼器２０の高さを低くでき、限られたスペースでも効率的な燃料蒸発器１の構成が可能となる。

【００２６】次に、本発明に係る燃料蒸発器１内の燃焼ガスが流れる高温熱媒体通路である燃焼ガス通路１３，１７，１８，１９について図２（ａ）および図５を参照して説明する。燃焼ガス通路１３，１７，１８，１９は、蒸発器本体１０の蒸発室１１の周囲に設けられ、蒸発室１１を加熱・保温するために設けられる高温熱媒体である燃焼ガスＨＧ，ＨＧ１，ＨＧ２の通路である。燃料電池５の水素極の被燃焼体であるオフガスＯＧは、燃料蒸発器１の入口部２１で２つの流れに分岐する。１つの流れは、熱媒チューブ１２の入口部１２ａに設けられた触媒燃焼部１４を通って高温の燃焼ガスＨＧを発生し、蒸発室１１内で液体原燃料ＦＬを蒸発した後、熱媒チューブ１２の上方の出口部１２ｂから燃焼ガス通路１３に排出される。排出された燃焼ガスＨＧは、燃料蒸発器１の手前に設けられた燃焼ガス通路１８、左側面に設けられた燃焼ガス通路１７を通過する。もう１つの流れは、蒸発室１０の下面１０Ａに隣接して設けられた触媒燃焼器２０を通って燃料蒸発器１の裏側から上昇して前記燃焼ガス通路１７に排出される。燃焼ガス通路１７に排出された高温熱媒体である燃焼ガスＨＧ１は、前記燃焼ガス通路１８からの高温熱媒体である燃焼ガスＨＧと合流し、合流した高温熱媒体である燃焼ガスＨＧ２は、燃焼ガス通路１９および出口部２２を通って過熱部３０へと導入され原燃料ガスＦＧを過熱する。過熱された原燃料ガスＦＧは改質器２へと導入され、燃焼ガスＨＧ２は、排ガスとして系外に排出される。

【００２７】このように、熱媒チューブ１２の内側に設

けた触媒燃焼部１４から排出される燃焼ガスＨＧおよび蒸発室１１の下面１０Ａに設けた触媒燃焼器２０から排出される燃焼ガスＨＧ１を、蒸発室の加熱・保温ができるように高温熱媒体通路である燃焼ガス通路１３，１７，１８，１９を設けて蒸発室１１の周囲に通流させることにより、燃焼ガスＨＧ、ＨＧ１、ＨＧ２の保有熱量を蒸発室１１に与え、蒸発室１１内における液体原燃料ＦＬの速やかな蒸発にさらに有効に利用できる。

【００２８】以上述べたように、燃料蒸発器１の蒸発室１１内の熱媒チューブ１２の内側に、触媒燃焼反応により被燃焼体であるオフガスＯＧを燃焼させる触媒燃焼部１４を設け、触媒燃焼器と燃料蒸発器を一体化した構成とすることに燃料蒸発器全体の高さを小さくできる。また、一体化することにより、従来問題となっていた触媒燃焼器から燃料蒸発器の熱媒チューブ１２までの配管から系外への熱損失がなくなる。さらに蒸発室１１の下面１０Ａに隣接するように触媒燃焼器２０を設け、前記蒸発室１１の周囲には高温熱媒体通路である燃焼ガス通路１３，１７，１８，１９を配設する構成としたことにより、燃料蒸発器１の高さＨを低くすることができ、かつ、熱媒チューブ１２の内側に設けた触媒燃焼部１４および蒸発室１１の下面に設けた触媒燃焼器２０で発生した燃焼ガスＨＧ，ＨＧ１の保有熱量を有効に利用することができる燃焼ガス通路１３，１７，１８，１９を備えた燃料蒸発器１を提供することができる。

【００２９】

【発明の効果】以上の構成と作用から明らかなように、本発明によれば、

１）蒸発室内の熱媒チューブの内側に、触媒燃焼反応により被燃焼体を燃焼させる触媒燃焼部を設けて、触媒燃焼器と燃料蒸発器を一体化した構成とすることにより、従来、燃料蒸発器の前段に設けられていた触媒燃焼器の設置スペースを不要とし、燃料蒸発器全体の高さを小さくできる。その結果、特に車両に燃料電池システムを搭載したときの車高を小さくすることができる。また、触媒燃焼器と燃料蒸発器を一体化した構成とすることにより、触媒燃焼器から燃料蒸発器の熱媒チューブまでの配管から系外への熱損失がなくなる。

２）蒸発室の下面に触媒燃焼器を隣接するように設けて、蒸発室の加熱・保温用の高温熱媒体を発生させ、蒸発室内の熱媒チューブ内の触媒燃焼部で発生した高温熱媒体を蒸発室の周囲に設けた高温熱媒体通路に通流させて、さらに蒸発室を加熱・保温することにより、速やかに蒸発が行われる。従って、触媒燃焼器および高温熱媒体通路を設けない場合と比較して、触媒燃焼器でのオフガスを燃焼する量を少なくできるので、触媒装填量を減らすことができる。その結果、触媒燃焼器の高さを低くでき、全体として燃料蒸発器をコンパクト化することができる。

【図面の簡単な説明】

【図１】本発明に係る燃料電池システムの全体系統図である。

【図２】（ａ）は、本発明に係る燃料蒸発器の側断面図である。（ｂ）は、図２（ａ）のＸ－Ｘ′断面図である。（左半分省略）。

【図３】（ａ）本発明に係る触媒燃焼部の第一実施形態を示す横断面の斜視図である。

（ｂ）本発明に係る触媒燃焼部の第二実施形態を示す横断面の斜視図である。

【図４】（ａ）本発明に係る触媒燃焼器の第一実施形態を示す横断面の斜視図である。

（ｂ）本発明に係る触媒燃焼器の第二実施形態を示す横断面の斜視図である。

（ｃ）本発明に係る触媒燃焼器の第三実施形態を示す横断面の斜視図である。

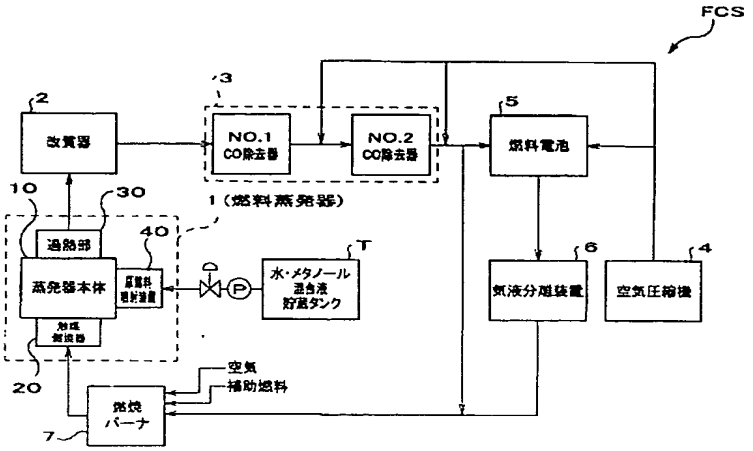
【図５】本発明に係る燃料蒸発器の燃焼ガス通路を示す斜視図である。

【図６】従来の燃料蒸発器の側断面図である。

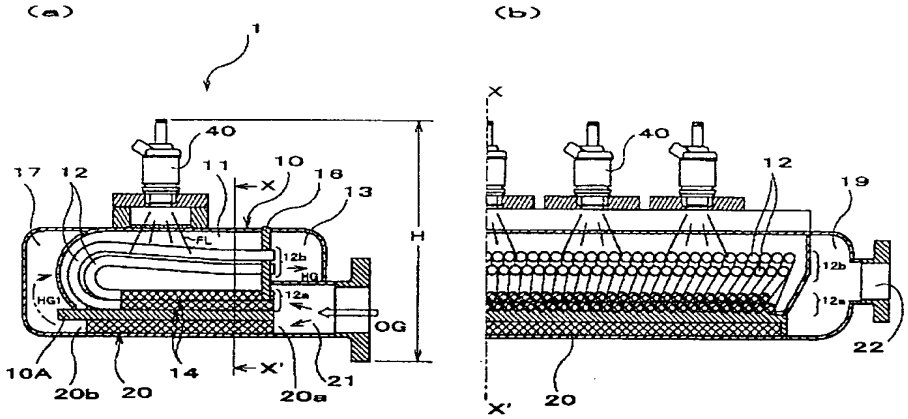
【符号の説明】

１　燃料蒸発器
１０　蒸発器本体
１１　蒸発室
１２　熱媒チューブ
１３，１７，１８，１９　燃焼ガス通路（高温熱媒体通路）
１４　触媒燃焼部
２０　触媒燃焼器
３０　過熱部
Ｈ　燃料蒸発器の高さ
ＨＧ，ＨＧ１，ＨＧ２　燃焼ガス（高温熱媒体）

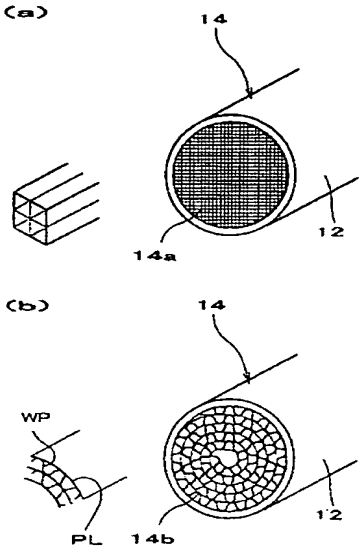
【図１】


FCS
2
改質器
3
NO.1
CO除去器
NO.2
CO除去器
5
燃料電池
10
30
1（燃料蒸発器）
過熱部
40
蒸発器本体
T
水・メタノール
混合液
貯蔵タンク
6
気液分離装置
4
空気圧縮機
20
空気
補助燃料
燃焼
バーナ
7

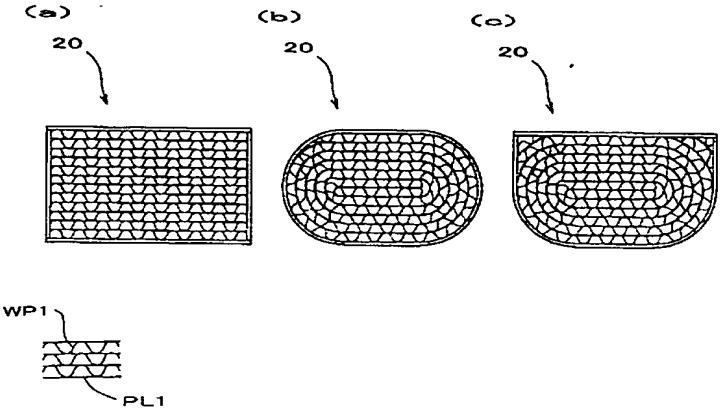
【図２】


(a)
(b)
1
40
17
12
11
10
16
13
X
FL
12b
HG
12a
HG1
OG
H
10A
20b
20
14
X'
20a
21
X
40
12
19
12b
12a
22
20
X'

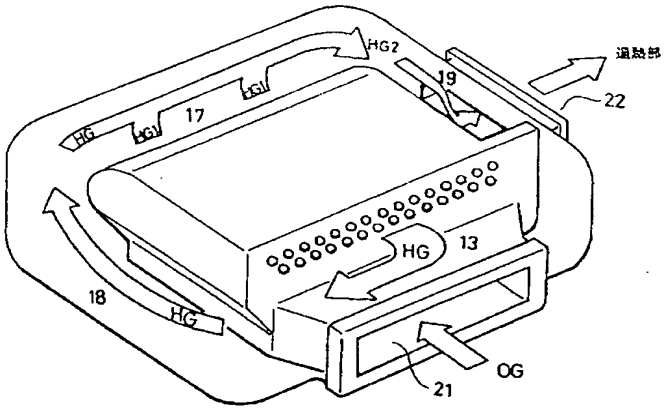
【図３】


(a)
14
14a
12
(b)
14
WP
PL
14b
12

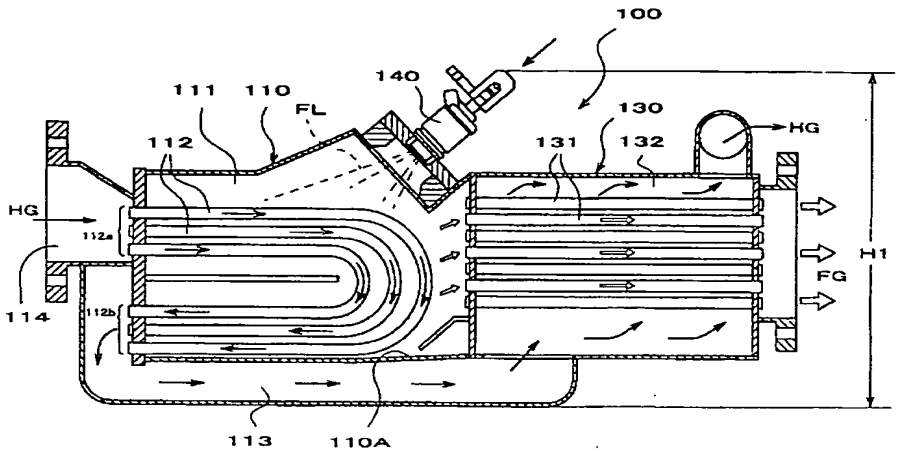
【図４】


(a)
20
(b)
20
(c)
20
WP1
PL1

【図５】


HG2
HG1
HG
17
19
22
HG
13
18
HG
OG
21

【図６】



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3K052
5H027

[F term (reference)]

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3K052 AA01 AB10 CA01 CA14
5H027 AA02 BA01

[Translation done.]

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Epitome

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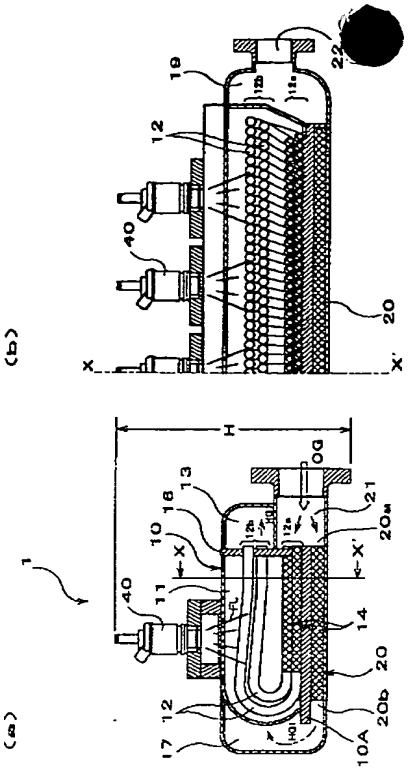
(57) [Abstract]
[Technical problem] It aims at offering the fuel evaporator which can make the height of a fuel evaporator low and can lessen heat loss from piping of the heating medium for higher temperature which carried out catalyzed combustion and was generated to the outside of a system.
[Means for Solution] Let the fuel evaporator characterized by having the thermal tube which lets the heating medium for higher temperature which can evaporate a liquid Hara fuel pass, and having the catalyzed combustion section 14 which burns the burned body into said thermal tube 12 in the fuel evaporator which has the evaporation chamber which evaporates said liquid Hara fuel with the heat obtained from said thermal tube be a solution means.

[Translation done.]



[Translation done.]

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CLAIMS

[Claim(s)]
[Claim 1] The fuel evaporator characterized by having the thermal tube which lets the heating medium for higher temperature which can evaporate a liquid Hara fuel pass, and having the catalyzed combustion section which burns the burned body into said thermal tube in the fuel evaporator which has the evaporation chamber which evaporates said liquid Hara fuel with the heat obtained from said thermal tube.
[Claim 2] The fuel evaporator according to claim 1 characterized by equipping the part except said evaporation chamber having adjoined the catalyzed combustion machine contiguous to said evaporation chamber with the heating-medium-for-higher-temperature path as for which said heating medium for higher temperature after evaporating said liquid Hara fuel carries out conduction.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the fuel evaporator equipped with the catalyzed combustion section which burns the burned body inside the thermal tube of the evaporation interior of a room in more detail about the fuel evaporator of the liquid Hara fuel in a fuel cell system.
[0002]
[Description of the Prior Art] A fuel cell system is a generation-of-electrical-energy system which made the nucleus the fuel cell which generates electricity by supplying the oxidation gas containing oxygen to the oxygen pole (anode plate) of a fuel cell while supplying it to the hydrogen pole (cathode) of a fuel cell by making hydrogen into fuel gas. This fuel cell system transforms chemical energy into direct electrical energy, and since there are very few discharges of having high generating efficiency or harmful matter, it attracts attention recently.
[0003] The fuel evaporator used by the conventional fuel cell system is indicated by Japanese Patent Application No. No. 125366 [11 to]. The inlet-port section 114 for this fuel evaporator 100 to introduce into the body 110 of an evaporator the combustion gas HG which is the heating medium for higher temperature generated by burning the burned body in catalytic reaction in the catalyzed combustion machine, as shown in drawing 6 , Conduction of said combustion gas HG is carried out to the inside from inlet-port section 112a of the thermal tube 112 of U typeface to outlet section 112b. With the evaporation chamber 111 which makes it evaporate with the heat which can obtain the liquid Hara fuel floor line injected by the outside surface of said thermal tube 112 from the original fuel injection equipment 140 from said combustion gas HG The combustion gas path 113 established in inferior-surface-of-tongue 110A of an evaporation chamber 111 in which said combustion gas HG after evaporating the liquid Hara fuel floor line carries out conduction, The principal part consists of hot spots 130 formed from the overheating room 132 and the steamy tube 131 for overheating the original fuel gas FG which evaporated in said evaporation chamber 111 by the combustion gas HG which went via said combustion gas path 113.
[0004] As mentioned above, an operation of the conventional fuel evaporator 100 constituted is described. The combustion gas HG which is the heating medium for higher temperature which the burned body was burned and was generated with the catalyzed combustion vessel which is not illustrated is introduced into the inlet-port section 114 of the body 110 of an evaporator. The combustion gas HG introduced into the inlet-port section 114 passes from inlet-port section 112a in the thermal tube 112 which carried out U typeface in an evaporation chamber 111 to outlet section 112b from a top to the bottom, and evaporates the liquid Hara fuel floor line injected by the outside surface of said thermal tube 112 with the original fuel injection equipment 140 in an evaporation chamber 111. Next, combustion gas HG after evaporating said liquid Hara fuel floor line is led to the overheating room 132 of a hot spot 130 via the combustion gas path 113, and overheats further the original fuel gas FG which evaporated in the evaporation chamber 111 from the outside of the steamy tube 131. The overheated original fuel gas FG is introduced to the reforming machine which is not illustrated, and combustion gas HG after

overheating original fuel [redacted]G is discharged out of a system as ex[redacted]t gas.
[0005] However, in order that the conventional fuel evaporator 100 [redacted]t establish the combustion gas path 113 in inferior-surface-of-tongue 110A of the evaporation chamber 111 of the body 110 of an evaporator as shown in drawing 6 or might adjoin and form the catalyzed combustion machine which is not illustrated in inferior-surface-of-tongue 110A of an evaporation chamber 111, when the height H1 of the whole fuel evaporator 100 became high and a fuel cell system was carried in a car, it had the problem that a car height will become high. Moreover, when a catalyzed combustion machine was adjoined and formed in inferior-surface-of-tongue 110A of an evaporation chamber 111, there was a problem that the amount of potential heat of the hot combustion gas HG which there is heat loss to the outside of a system by the way (temperature-reduction deltaT=20-30 degree C), and occurred with the catalyzed combustion vessel with much trouble of piping from the outlet of a catalyzed combustion machine to the thermal tube 112 in an evaporation chamber 111 will become useless.
[0006]
[Problem(s) to be Solved by the Invention] This invention aims at offering the fuel evaporator which can be made in order to solve said technical problem, can make the height of a fuel evaporator low, and can lessen heat loss from piping of the heating medium for higher temperature which carried out catalyzed combustion and was generated to the outside of a system.
[0007]
[Means for Solving the Problem] The place which makes into the summary of invention indicated by claim 1 for solving said technical problem is characterized by to have the thermal tube which lets the heating medium for higher temperature which can evaporate a liquid Hara fuel pass , and to have the catalyzed combustion section which burns the burned body into said thermal tube in the fuel evaporator which has the evaporation chamber which evaporates said liquid Hara fuel with the heat obtained from said thermal tube .
[0008] By preparing the catalyzed combustion section which burns the burned body by the catalyzed combustion reaction inside the thermal tube of the evaporation interior of a room, and considering as the configuration which unified the catalyzed combustion machine and the fuel evaporator, conventionally, the installation tooth space of a catalyzed combustion machine provided for the preceding paragraph of a fuel evaporator is made unnecessary, and height H of the whole fuel evaporator can be made small. Consequently, the car height when carrying a fuel cell system in a car can be made small. Moreover, the heat loss from piping from a catalyzed combustion machine to the thermal tube of a fuel evaporator to the outside of a system is lost by considering as the unified configuration.
[0009] The place made into the summary of invention indicated by claim 2 for solving said technical problem is a fuel evaporator according to claim 1 characterized by equipping the part except said evaporation chamber having adjoined the catalyzed combustion machine contiguous to said evaporation chamber with the heating-medium-for-higher-temperature path as for which said heating medium for higher temperature after evaporating said liquid Hara fuel carries out conduction.
[0010] Evaporation is promptly performed by forming a catalyzed combustion machine so that the inferior surface of tongue of an evaporation chamber may be adjoined, making the heating-medium-for-higher-temperature path which formed the heating medium for higher temperature it not only generates the heating medium for higher temperature for heating / incubation of an evaporation chamber, but generated in the catalyzed combustion section in the thermal tube of the evaporation interior of a room in the perimeter of an evaporation chamber carry out conduction, and heating and keeping an evaporation chamber warm further. Therefore, since the amount which carries out catalyzed combustion of the off-gas can be lessened as compared with the case where the account of catalyzed combustion and a heating-medium-for-higher-temperature path are not prepared, the amount of catalyst loading can be reduced. Consequently, the height of a catalyzed combustion machine can be made low and a fuel evaporator can be miniaturized as a whole.
[0011]

[Embodiment of the Inve[illegible]] The gestalt of operation of the fuel e[illegible]porator concerning this invention is explained with reference to a drawing. The whole fuel ce[illegible]ystem schematic diagram which drawing 1 requires for this invention, and drawing 2 (a) The sectional side elevation of the fuel evaporator concerning this invention and drawing 2 (b) The X-X' sectional view (left half abbreviation) of drawing 2 (a) and drawing 3 (a) The perspective view of the cross section showing the first operation gestalt of the catalyzed combustion section concerning this invention and drawing 3 (b) The perspective view of the cross section showing the second operation gestalt of the catalyzed combustion section concerning this invention and drawing 4 (a) The perspective view of the cross section showing the first operation gestalt of the catalyzed combustion machine concerning this invention and drawing 4 (b) The perspective view of the cross section showing the third operation gestalt of the catalyzed combustion machine which the perspective view of the cross section showing the second operation gestalt of the catalyzed combustion machine concerning this invention and drawing 4 (c) require for this invention, and drawing 5 are the perspective views showing the combustion gas path of the fuel evaporator concerning this invention.

[0012] First, the whole fuel cell system FCS which starts this invention with reference to drawing 1 and drawing 2 is explained. The fuel cell system FCS carried in a car In the evaporation chamber 11 of the body 10 of an evaporator The fuel evaporator 1 equipped with the catalyzed combustion section 14 inside the thermal tube 12 of U typeface which evaporates said liquid Hara fuel floor line which carries out conduction of the combustion gas HG which is the heating medium for higher temperature which carried out catalyzed combustion of the off-gas OG of a fuel cell 5 to the inside, and was generated, and contacts by the outside surface, and said thermal tube 12, The reforming machine 2 which the original fuel gas FG which said liquid Hara fuel floor line was evaporated, and was generated with said fuel evaporator 1 is made to react on a solid-state catalyst, and makes it fuel gas, CO removal machine 3 from which the carbon monoxide in said fuel gas generated with said reforming vessel 2 is removed, The fuel cell 5 which generates electricity by making the hydrogen in the fuel gas supplied from said CO removal machine 3, and the oxygen in the air compressed by the air compressor 4 which is an oxidizer supply means react, The vapor-liquid-separation equipment 6 which separates and removes moisture from the off-gas OG of the hydrogen pole of a fuel cell 5, It is constituted including the combustion burner 7 which has the supply line of the auxiliary fuel (for example, methanol) which generates the combustion gas HG which is the heating medium for higher temperature which burns Off-gas OG and the auxiliary fuel which are supplied from vapor-liquid-separation equipment 6, and serves as a source of heating of the fuel evaporator 1 in the time of starting etc.

[0013] An operation of the fuel cell system FCS constituted as mentioned above is described. Specified quantity supply of the liquid Hara fuel floor line (for example, composite fuel of a methanol and water) is carried out from liquid Hara fuel storage tank T with a pump at the fuel evaporator 1. The liquid Hara fuel floor line supplied to the body 10 of an evaporator of the fuel evaporator 1 is injected by the outside surface of the thermal tube 12 of U typeface prepared in the evaporation chamber 11 of the body 10 of an evaporator by the original fuel injection equipment 40. In said thermal tube 12 in said evaporation chamber 11, the combustion gas HG which is the heating medium for higher temperature which burned and generated the off-gas OG of the hydrogen pole of a fuel cell 5 in the catalyzed combustion section 14 prepared inside the thermal tube 12 is flowing, and said liquid Hara fuel floor line evaporates as original fuel gas FG in an evaporation chamber 11 with the heat obtained from said combustion gas HG through the thermal tube 12. As a source of heating of the body 10 of an evaporator, although the combustion gas HG which occurs by burning and carrying out catalyzed combustion of Off-gas OG and the auxiliary fuel of a hydrogen pole of a fuel cell 5 in the catalyzed combustion section 14 in the thermal tube 12 is used at the time of operation, when there is no source of heating at the time of starting etc., an auxiliary fuel (for example, methanol) is burned by the combustion burner 7, and a need heating value can be secured.

[0014] the original fuel gas FG which it was overheated to the temperature which is not condensed by the hot spot 30, and the original fuel gas FG which occurred by said body 10 of an

evaporator was introduced to the reforming machine 2, and was introduced into the reforming machine 2 is made to react on a solid-state catalyst (for example, catalyst of a Cu-Zn system) -- having -- hydrogen -- rich fuel gas is manufactured. furthermore, the hydrogen generated with the reforming vessel 2 -- after rich fuel gas is removed by CO removal machine 3 in the carbon monoxide in gas, it is introduced into the fuel cell 5 which generates electricity by making the hydrogen in the fuel gas supplied from said CO removal machine 3, and the oxygen in the air compressed by the air compressor 4 which is an oxidizer supply means react. After the off-gas OG of the hydrogen pole after reacting with a fuel cell 5 is separated and removed by vapor-liquid-separation equipment 6 in moisture, it burns in the catalyzed combustion section 14 again, and serves as a source of heating of the body 10 of an evaporator. In addition, as long as it has the heating value which the original fuel gas FG which occurred by the body 10 of an evaporator does not fully condense, you may introduce into the direct reforming machine 2, without letting a superheater 30 pass.

[0015] Hereafter, the operation gestalt of the fuel evaporator 1 applied to this invention with reference to drawing 2 thru/or drawing 5 is explained to a detail. The inlet-port section 21 of the fuel evaporator 1 which introduces the off-gas OG of the hydrogen pole of a fuel cell 5 whose fuel evaporator 1 concerning this invention is the burned body, By the combustion gas HG which is the heating medium for higher temperature which forms successively in said inlet-port section 21, has the catalyzed combustion section 14 which carries out catalyzed combustion to the inside through said the greater part of off-gas OG, and is generated from said catalyzed combustion section 14 The thermal tube 12 which carried out U typeface which evaporates the liquid Hara fuel floor line which contacts by the outside surface, With the evaporation chamber 11 which is a room surrounding the tube attaching part 16 holding said thermal tube 12, and said thermal tube 12 and said tube attaching part 16 The body 10 of an evaporator which consists of original fuel injection equipments 40 which are formed in the upper part of said evaporation chamber 11, and inject the liquid Hara fuel floor line in said evaporation chamber 11, The combustion gas paths 13, 17, 18, and 19 whose combustion gas HG after evaporating the liquid Hara fuel floor line in said evaporation chamber 11 is the heating-medium-for-higher-temperature path established in the perimeter of an evaporation chamber 11 so that the flank of an evaporation chamber 11 might be kept warm, The catalyzed combustion machine 20 which evaporates the liquid Hara fuel floor line of evaporation-chamber 11 pars basilaris ossis occipitalis by the combustion gas HG1 which is the heating medium for higher temperature to which it is adjacently prepared in inferior-surface-of-tongue 10A of said evaporation chamber 11, and catalyzed combustion of the residue of said off-gas OG was carried out, the hot spot 30 which overheats original fuel gas FG by the combustion gas HG2 which is the heating medium for higher temperature with which said combustion gas HG1 and the combustion gas HG passing through said combustion gas paths 13 and 18 joined and which is not illustrated -- since -- the principal part is constituted.

[0016] Next, an operation of the fuel evaporator 1 concerning this invention is explained with reference to drawing 2 . The off-gas OG of the hydrogen pole of the fuel cell 5 which is the burned body passes along the inlet-port section 21 of the fuel evaporator 1, and branches with two flow by inlet-port section 12a of the thermal tube 12 of U typeface held at the tube attaching part 16.

[0017] As one of the branched flow is shown in drawing 2 , it flows to the catalyzed combustion section 14 prepared in inlet-port section 12a of the thermal tube 12 as it was, and Off-gas OG is burned, the combustion gas HG which is a heating medium for higher temperature is generated, and the generated hot combustion gas HG flows upwards the inside of the thermal tube 12 of U typeface prepared in the evaporation chamber 11 from the bottom. When it passes along the inside of the thermal tube 12 which carried out U typeface in an evaporation chamber 11, said combustion gas HG evaporates the liquid Hara fuel floor line injected by the original fuel injection equipment 40 to the outside surface of said thermal tube 12 with the potential heat of combustion gas HG, and generates original fuel gas FG. Next, combustion gas HG after evaporating the liquid Hara fuel floor line is discharged by the combustion gas path 13 from outlet 12b of the thermal tube 12, and as shown in drawing 5 , it joins the combustion gas HG1

which is the heating med[redacted]for higher temperature generated with[redacted]catalyzed combustion vessel 20 at the combustion gas path 17 via the combustion gas pa[redacted]13 and 18 prepared as surrounded the surroundings of an evaporation chamber 11. The combustion gas HG2 which is the heating medium for higher temperature which furthermore joined is led to a hot spot 30 (refer to drawing 1) through the combustion gas path 19 and the outlet section 22, and is overheated to the temperature which does not condense the original fuel gas FG which evaporated in the evaporation chamber 11.

[0018] As show in drawing 2 , one flow which will be accept on the other hand while branch be adjoin and prepare in inferior surface of tongue 10A of an evaporation chamber 11 , and generate the combustion gas HG1 which be a heating medium for higher temperature from outlet 20b of a catalyzed combustion machine by flow to inlet port section 20a of the catalyzed combustion machine 20 which carried out the rectangular cross section configuration , and burn Off-gas OG with the catalyst with which it be loaded . After the combustion gas HG1 which occurred with the catalyzed combustion vessel 20 evaporates the liquid Hara fuel floor line of evaporation-chamber 11 pars basilaris ossis occipitalis, as it is shown in drawing 5 , it joins at the combustion gas HG and the combustion gas path 17 which were discharged from the evaporation chamber 11, and the combustion gas HG2 which joined is led to the hot spot 30 which is prepared in the latter part of an evaporation chamber 11 through the combustion gas paths 19 and 22 and which is not illustrated. The combustion gas HG2 which came out of the hot spot 30 is discharged out of a system as exhaust gas, and the overheated original fuel gas FG is introduced to the reforming machine 2.

[0019] Next, the catalyzed combustion section 14 prepared in the thermal tube 12 of the fuel evaporator 1 concerning this invention is explained to a detail with reference to drawing 3 . The catalyzed combustion section 14 loads with the same ****** as the catalyst of the conventional catalyzed combustion machine inside the thermal tube 12 in the evaporation chamber 11 of the fuel evaporator 1, and unifies a catalyzed combustion machine and a fuel evaporator. The structure of the catalyzed combustion section 14 of the first operation gestalt loads with grid-like honeycomb catalyst 14a into the thermal tube 12, as shown in drawing 3 (a). In drawing 3 (a), although the configuration of a catalyst cel shows four square shapes, the thing of six square shapes may be used. As a process of honeycomb catalyst 14a, support with big specific surface area, such as gamma-alumina and a zirconium dioxide, is covered to a ceramic carrier surface, and a catalyst is usually prepared by the approach of sinking in the active ingredient of platinum and others on it. Honeycomb catalyst 14a may load the thermal tube 12 with what supported the catalytic activity component to support, may load only with honeycomb support first, and it may prepare it so that the inside and honeycomb support of the thermal tube 12 may be made to support a catalytic activity component afterwards. Since honeycomb catalyst 14a can take the touch area of Off-gas OG and a catalytic activity component, and a large linear velocity of the gas within a catalyst, its life is longer than the time of loading with the granular catalyst for the fixed beds to plugging when passing the gas containing many solid content particles, such as dust. Although cordierite (2MgO-2aluminum2O3-5SiO), a mullite (3aluminum2O3-2SiO2), etc. are well used as ceramics, a metal can also be used for the quality of the material of the support of honeycomb catalyst 14a as support. Said honeycomb support is the support which extruded the pressure loss under the high rate-of-flow conditions, and mainly in the shape of [of the bee used in order to prevent powdering of the catalyst by the heat history] a blow hole, and was cast. Honeycomb support is suitable for carrying out small quantity (it being 1% or less to total amount of catalysts also including weight of honeycomb support) support of the high precious metal catalyst (for example, platinum) of specific activity.

[0020] As shown in drawing 3 (b), the structure of the catalyzed combustion section 14 of the second operation gestalt consists of a honeycomb object which wound about around the curled form by turns the catalyst cel which carried out soldering processing of the corrugated plate WP of the same material as the plate-like ferrite system stainless steel PL, and loads with it into the thermal tube 12 made from stainless steel (for example, SUS316L). It is joined by heat-resistant high nickel wax material between the plate-like ferrite system stainless steel PL and a corrugated plate WP and between said honeycomb objects and thermal tubes 12. The touch area

of the off-gas OG of a fuel cell 5 and a catalytic activity component can be enlarged by considering as the honeycomb object which formed the corrugated plate WP, and by having wound about so that the upper and lower sides of a corrugated plate WP might be inserted by monotonous PL, when loading into the thermal tube 12, deformation by the unbalanced load concerning a corrugated plate WP can be prevented. A catalyst may load the thermal tube 12 with what supported the catalytic activity component to metal support, may load only with metal support first, and it may prepare it so that the inside and said metal support of the thermal tube 12 may be made to support a catalytic activity component afterwards.

[0021] Although the structure of the catalyzed combustion section 14 of the third operation gestalt is not illustrated, it loads the support of the torsion fin of the configuration where one rectangular plate was twisted with the torsion fin catalyst which supported the metal active ingredient into the thermal tube 12 in an evaporation chamber 11. thus, twist by carrying out -- flow of the combustion gas HG which occurred in the catalyzed combustion section 14 in the thermal tube 12 with the fin can be turbulent-flow-ized. Since temperature distribution radial [in the thermal tube 12] are lost and a heat transfer coefficient becomes large by turbulent-flow-izing, the amount of potential heat of the combustion gas HG generated in the catalyzed combustion section 14 can use effective in evaporation of the liquid Hara fuel floor line in the evaporation chamber 11 of the body 10 of an evaporator. Therefore, evaporation of the liquid Hara fuel floor line can be promoted. A catalyst may load the thermal tube 12 with what supported the catalytic activity component to metal support, may load only with metal support first, and it may prepare it so that the inside and said metal support of the thermal tube 12 may be made to support a catalytic activity component afterwards.

[0022] Next, the structure of the catalyzed combustion machine 20 adjoined and prepared in inferior-surface-of-tongue 10A of an evaporation chamber 10 is explained with reference to drawing 4 . It is the facility for heating and keeping an evaporation chamber 11 warm from inferior-surface-of-tongue 10A of an evaporation chamber 11 by the combustion gas which carried out catalyzed combustion of the off-gas OG discharged from the hydrogen pole of a fuel cell 5, and occurred, and the catalyzed combustion machine 20 adjoins inferior-surface-of-tongue 10A of an evaporation chamber 11, it is stuck preferably and formed. The structure of the catalyzed combustion machine 20 of the first operation gestalt is carrying out the configuration where the cross-section configuration of a catalyst cel sandwiched the upper and lower sides of a corrugated plate WP 1 by monotonous PL1 as shown in drawing 4 (a), and a cross-section configuration carries out the laminating of said catalyst cel into rectangular piping, and loads with it. Thus, since the touch area (heating area) of inferior-surface-of-tongue 10A of an evaporation chamber 10 and the catalyzed combustion machine 20 can be enlarged to the maximum extent by making the cross-section configuration of the catalyzed combustion machine 20 into a rectangle, the amount of potential heat of the combustion gas HG1 which is the heating medium for higher temperature generated with the catalyzed combustion vessel 20 can be told effective in inferior-surface-of-tongue 10A of an evaporation chamber 10. Moreover, if the high catalyst of catalytic activity is used, the height of the catalyzed combustion machine 20 can be further made small. Therefore, the car height when carrying the fuel cell system FCS in a car can be made low.

[0023] As shown in drawing 4 (b), after the structure of the catalyzed-combustion machine 20 of the second operation gestalt is carrying out the cross-section configuration where of the cross-section configuration of a catalyst cel was monotonous, and sandwiched the upper and lower sides of the same corrugated plate as drawing 4 (a), carries out the laminating of said catalyst cel to the shape of a doughnut (the shape of a concentric circle) and loads with it into piping of a cylindrical shape, it crushes piping of a cylindrical shape from the upper and lower sides, and is carrying out the oblong ellipse of piping which formed the flat part up and down. By considering as such structure, a touch area (heating area) with inferior-surface-of-tongue 10A of an evaporation chamber 10 can be made larger than the time of loading piping of a cylindrical shape with a catalyst, and the amount of potential heat of the combustion gas HG1 which is the heating medium for higher temperature generated with the catalyzed combustion vessel 20 can be used effective in evaporation of the liquid Hara fuel floor line of evaporation-chamber 11 pars basilaris

ossis occipitalis.
[0024] As shown in drawing 4 (c), the structure of the catalyzed combustion machine 20 of the third operation gestalt cuts the top face of the catalyzed combustion machine 20 of the second operation gestalt, and is carrying out the oblong half-ellipse which turned welding attachment of the plate up. If it is made such structure, a touch area (heating area) with inferior-surface-of-tongue 10A of an evaporation chamber 11 can be further enlarged rather than the catalyzed combustion machine 20 of the second operation gestalt, and the amount of potential heat of the combustion gas HG1 which occurred with the catalyzed combustion vessel 20 can be used effective in evaporation of the liquid Hara fuel floor line of evaporation-chamber 11 pars basilaris ossis occipitalis.
[0025] Although the structure of the catalyzed combustion machine 20 of the fourth operation gestalt is not illustrated, it carries out the parallel arrangement of the piping of a cylindrical shape whose same cross-section configuration of the as the catalyzed combustion machine (refer to drawing 4 (a)) of the first operation gestalt loaded with the catalyst which is the catalyzed combustion section of the first operation gestalt of drawing 3 (a), or the catalyzed combustion section of the second operation gestalt of drawing 3 (b) at the inside of rectangular hollow piping horizontally. arranging horizontally -- the touch area (heating area) of the base of an evaporation chamber 11, and a catalyzed combustion machine -- the maximum -- it can do greatly, and a throughput can be raised without making the height of a catalyzed combustion machine high by making it a parallel arrangement. Consequently, the height of the catalyzed combustion machine 20 can be made low, and the configuration of the efficient fuel evaporator 1 is attained also in the limited tooth space.
[0026] Next, the combustion gas paths 13, 17, 18, and 19 which are heating-medium-for-higher-temperature paths where the combustion gas in the fuel evaporator 1 concerning this invention flows are explained with reference to drawing 2 (a) and drawing 5 . The combustion gas paths 13, 17, 18, and 19 are paths of the combustion gas HG, HG1, and HG2 which is the heating medium for higher temperature which is formed in the perimeter of the evaporation chamber 11 of the body 10 of an evaporator, and is formed in order to heat and keep an evaporation chamber 11 warm. The off-gas OG which is the burned body of the hydrogen pole of a fuel cell 5 branches with two flow in the inlet-port section 21 of the fuel evaporator 1. After one flow generates hot combustion gas HG through the catalyzed combustion section 14 prepared in inlet-port section 12a of the thermal tube 12 and evaporates the liquid Hara fuel floor line in an evaporation chamber 11, it is discharged by the combustion gas path 13 from upper outlet section 12b of the thermal tube 12. The discharged combustion gas HG passes through the combustion gas path 18 prepared before the fuel evaporator 1, and the combustion gas path 17 established in the left lateral. Another flow goes up from the background of the fuel evaporator 1 through the catalyzed combustion machine 20 adjoined and formed in inferior-surface-of-tongue 10A of an evaporation chamber 10, and is discharged by said combustion gas path 17. The combustion gas HG1 which is the heating medium for higher temperature discharged by the combustion gas path 17 joins the combustion gas HG which is a heating medium for higher temperature from said combustion gas path 18, and the combustion gas HG2 which is the heating medium for higher temperature which joined is introduced through the combustion gas path 19 and the outlet section 22 to a hot spot 30, and overheats original fuel gas FG. The overheated original fuel gas FG is introduced to the reforming machine 2, and combustion gas HG2 is discharged out of a system as exhaust gas.

[0027] Thus, the combustion gas HG1 discharged from the catalyzed combustion machine 20 formed in inferior-surface-of-tongue 10A of the combustion gas HG discharged from the catalyzed combustion section 14 prepared inside the thermal tube 12, and an evaporation chamber 11 By forming the combustion gas paths 13, 17, 18, and 19 which are heating-medium-for-higher-temperature paths so that heating and incubation of an evaporation chamber can be performed, and making the perimeter of an evaporation chamber 11 carry out conduction The amount of potential heat of combustion gas HG, HG1, and HG2 is given to an evaporation chamber 11, and it can use still more effective in prompt evaporation of the liquid Hara fuel floor line in an evaporation chamber 11.

[0028] As stated above, t[redacted]eight of the whole fuel evaporator can[redacted]made small considering as the configuration which formed the catalyzed combustion section[redacted] which burns the off-gas OG which is the burned body by the catalyzed combustion reaction inside the thermal tube 12 in the evaporation chamber 11 of the fuel evaporator 1, and united the catalyzed combustion machine and the fuel evaporator with it. Moreover, the heat loss from piping from the catalyzed combustion machine which had become a problem conventionally to the thermal tube 12 of a fuel evaporator to the outside of a system is lost by unifying. By having formed the catalyzed combustion machine 20 so that inferior-surface-of-tongue 10A of an evaporation chamber 11 might furthermore be adjoined, and having considered as the configuration which arranges in the perimeter of said evaporation chamber 11 the combustion gas paths 13, 17, 18, and 19 which are heating-medium-for-higher-temperature paths Height H of the fuel evaporator 1 can be made low. The fuel evaporator 1 equipped with the combustion gas paths 13, 17, 18, and 19 which can use effectively the amount of potential heat of the combustion gas HG and HG1 which occurred with the catalyzed combustion vessel 20 formed in the inferior surface of tongue of the catalyzed combustion section 14 and the evaporation chamber 11 which prepared inside the thermal tube 12 can be offered.

[0029]

[Effect of the Invention] according to this invention , by prepare the catalyzed combustion section which burn the burn body by the catalyzed combustion reaction inside the thermal tube of the 1 evaporation interior of a room , and consider as the configuration which unified the catalyzed combustion machine and the fuel evaporator , conventionally , the installation tooth space of a catalyzed combustion machine provided for the preceding paragraph of a fuel evaporator be make unnecessary , and the height of the whole fuel evaporator can be make small so that clearly from the above configuration and operation . The car height when carrying a fuel cell system in the result, especially a car can be made small. Moreover, the heat loss from piping from a catalyzed combustion machine to the thermal tube of a fuel evaporator to the outside of a system is lost by considering as the configuration which unified the catalyzed combustion machine and the fuel evaporator.

2) Evaporation is promptly performed by making the heating-medium-for-higher-temperature path which prepared so that the inferior surface of tongue of an evaporation chamber might be adjoined in a catalyzed combustion machine, and formed the heating medium for higher temperature which was made to generate the heating medium for higher temperature for heating / incubation of an evaporation chamber, and was generated in the catalyzed combustion section in the thermal tube of the evaporation interior of a room in the perimeter of an evaporation chamber carry out conduction, and heating and keeping an evaporation chamber warm further. Therefore, since the amount which burns the off-gas in a catalyzed combustion machine can be lessened as compared with the case where a catalyzed combustion machine and a heating-medium-for-higher-temperature path are not prepared, the amount of catalyst loading can be reduced. Consequently, the height of a catalyzed combustion machine can be made low and a fuel evaporator can be miniaturized as a whole.

[Translation done.]

* NOTICES *

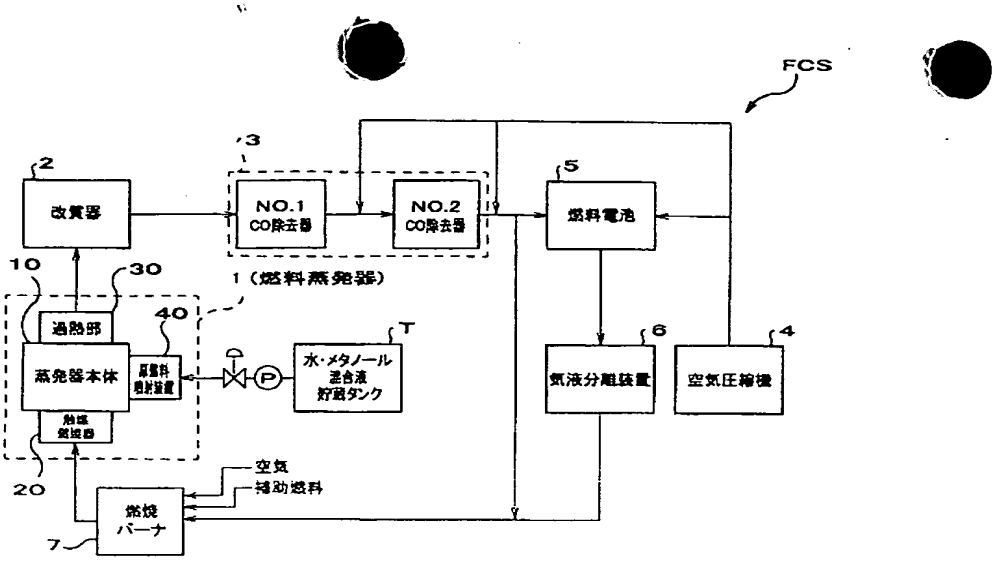
DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the whole fuel cell system schematic diagram concerning this invention.
[Drawing 2] (a) is the sectional side elevation of the fuel evaporator concerning this invention. (b) is the X-X' sectional view of drawing 2 (a). (Left half abbreviation) .
[Drawing 3] (a) It is the perspective view of the cross section showing the first operation gestalt of the catalyzed combustion section concerning this invention.
(b) It is the perspective view of the cross section showing the second operation gestalt of the catalyzed combustion section concerning this invention.
[Drawing 4] (a) It is the perspective view of the cross section showing the first operation gestalt of the catalyzed combustion machine concerning this invention.
(b) It is the perspective view of the cross section showing the second operation gestalt of the catalyzed combustion machine concerning this invention.
(c) It is the perspective view of the cross section showing the third operation gestalt of the catalyzed combustion machine concerning this invention.
[Drawing 5] It is the perspective view showing the combustion gas path of the fuel evaporator concerning this invention.
[Drawing 6] It is the sectional side elevation of the conventional fuel evaporator.
[Description of Notations]
1 Fuel Evaporator
10 Body of Evaporator
11 Evaporation Chamber
12 Thermal Tube
13, 17, 18, 19 Combustion gas path (heating-medium-for-higher-temperature path)
14 Catalyzed Combustion Section
20 Catalyzed Combustion Machine
30 Hot Spot
H Height of a fuel evaporator
HG, HG1, HG2 Combustion gas (heating medium for higher temperature)

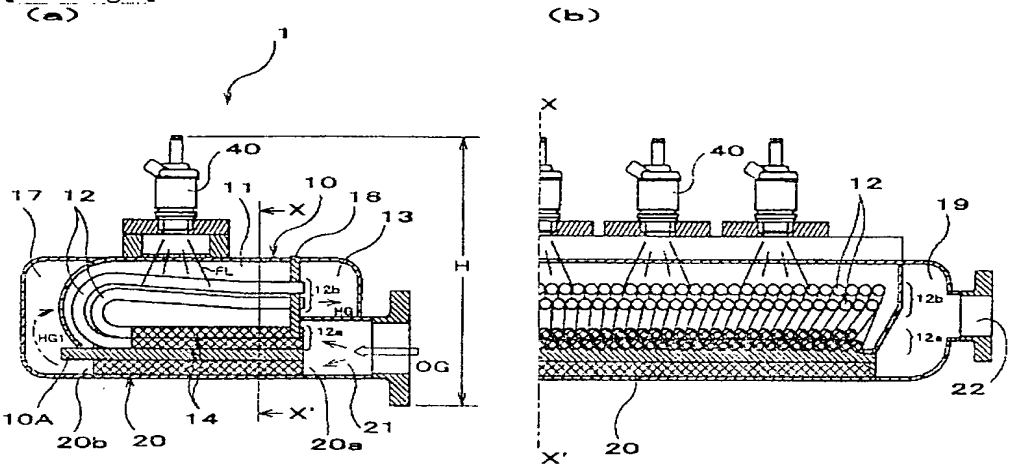
[Translation done.]

DRAWINGS

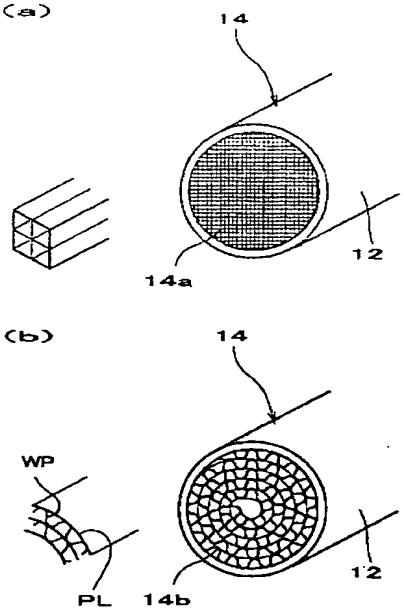
[Drawing 1]



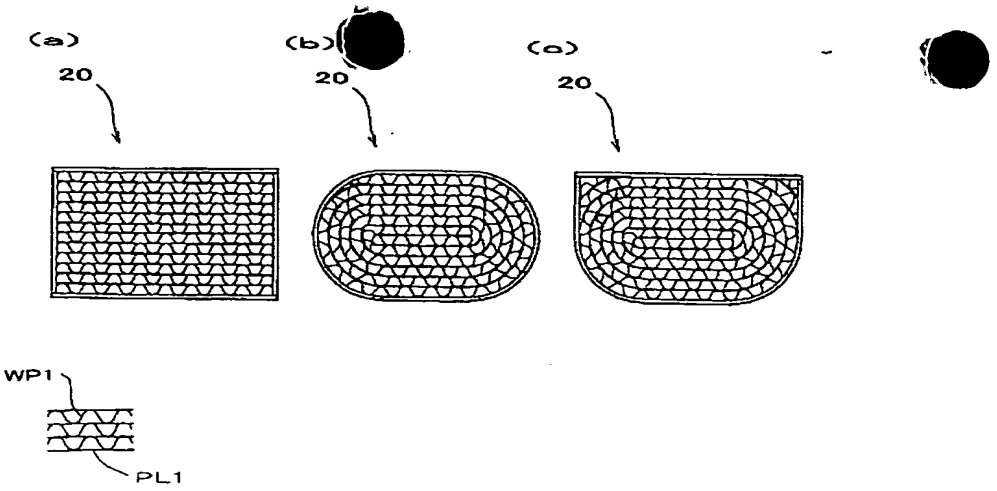
[Drawing 2]



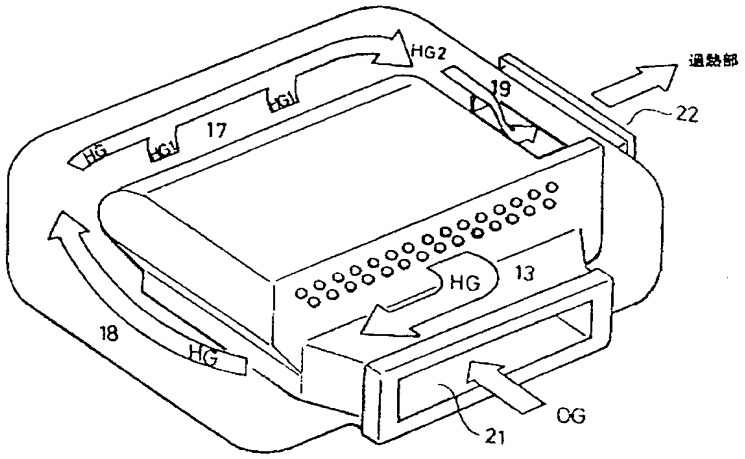
[Drawing 3]



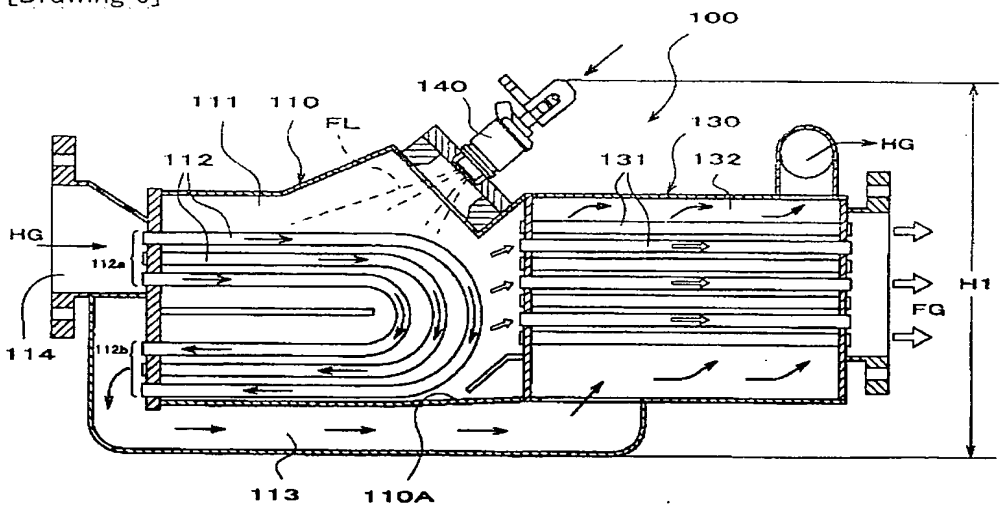
[Drawing 4]



[Drawing 5]



[Drawing 6]



[Translation done.]